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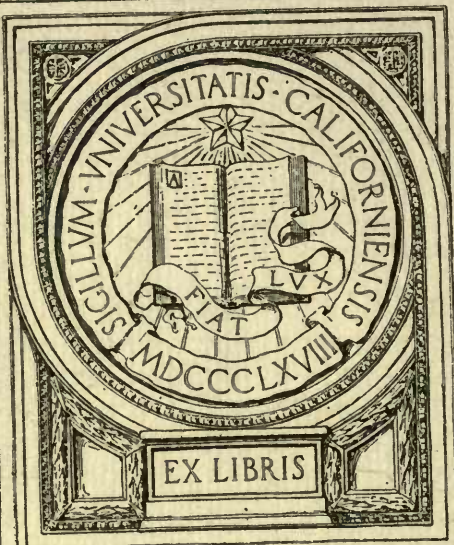

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Chestnut Culture in the Northeastern United States.

By E. A. STERLING.

CONTINENTAL EUROPE, by reason of its long-established civilization, density of population, and development of its natural resources, is able to teach a much needed lesson in conservation to the wasteful young nations, among which the United States is a fair sample. Especially in the development of the various branches of forestry, most of the old world countries have taken marked precedence over us; and everywhere abroad a more complete utilization of all major and minor forest products is found, together with a more careful provision for the future needs of the people, than in this country.

Chestnut Culture Abroad.

As it is the chestnut with which we are now concerned we must look to Italy, Spain, and parts of France for our lesson, as there will be found the highest development of this branch of forestry, or horticulture, whichever it deserves to be called.

In Italy the chestnut has long been of great commercial value, ranking in many parts with the grape and olive as a source of revenue, but more often serving as a cheap and nutritious food supply to the poor peasant than as an article of commerce. Wherever found in the countries bordering the Mediterranean, whether growing naturally or in cultivated orchards, the chestnut is highly prized, both on account of its finely flavored nuts and its valuable wood.

In the uses of the chestnut the Italians are connoisseurs, and from them we have much to learn as to the methods used in preparing it for food. Their ability to dry and preserve the nuts so that they retain all of their original flavor and sweetness, without becoming dry and unpalatable, is an unpracticed art with us, but one which necessity will soon compel us to acquire if the nuts continue to grow in popular favor. On the streets of many foreign cities the nuts are sold by street venders the year around, as peanuts are in American cities, while among the com-

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mon people the bread made from chestnut flour is a staple article of diet. The nuts, too, are often cooked as a vegetable, made into a soup or prepared as a pudding, and when candied have a ready sale as an article of confectionery.

The wood finds ready sale for a variety of purposes, as in this country. The bark yields tannin, the coppice makes first-class vine stakes, while the large tree trunks furnish wood material of various kinds, suitable wherever durability is desired. It is asserted that there are chestnut trees on the slopes of Mt. Ætna which bore fruit when Homer was a boy.

The Chestnut in America.

Turning to our own country and our own State we find the chestnut occupying relatively a much less important position than abroad, the reason, perhaps, being in the fact that because of the greater diversity of valuable tree species there is less need of giving especial attention to any one. Another reason may be found in the certainty that the chestnut is not yet fully appreciated, nor its many virtues and capabilities fully known. Among the broad-leaved trees it is hard to find its equal. It is a rapid grower on soils of good or medium quality, forms a vigorous coppice (root sprouts), yields a wood which, because of the tannic acid it contains, is very durable in contact with the ground, and is very valuable for fuel, fence-posts, cross-ties, telegraph poles and interior house furnishing, while last, and perhaps most important, it yields a fruit in the form of a very valuable nut.

Until quite recently the nut has not been accorded anything like its true value; it has been considered as a luxury rather than as a valuable food product or article of commerce. In clearing away the virgin forest the chestnut, along with the walnut and hickory, has sometimes been left in the pasture lots and fence corners for the sake of the wholesome crop of nuts which were sure to result. Trees, too, have been planted near gateways and along roadsides for the sake of both shade and fruit; but anything like the systematic planting of chestnut orchards on a commercial scale has not been extensively attempted until within the last decade.

The nuts which were produced on the native trees scattered through the pasture lands and along the edge of the wood lots were not generally looked upon by the farmer as possessing any value worthy of his attention. The squirrels and the children were usually the ones most interested, and it was often a question as to whom fell the greater share. The squirrels, with an eye to the future, and a knowledge that the chestnut is a valuable article of diet, assiduously stored away large quantities of nuts where they would serve as a granary during the midwinter star-

vation period. The children, on the other hand, being assured of a winter food supply from other sources, gathered the chestnuts partly for pleasure, and, in part, to obtain pin money. Pleasure and profit were thus well combined, because for a merry band of young people to wander through the autumn woods in search of nuts was a pleasure which cannot be readily appreciated by the dwellers in urban communities. The nuts thus collected, which were not dried and kept as winter companions for the apples and cider, were usually sold to the local storekeepers who forwarded them to city commission merchants, whence they found their way to the city markets. Occasionally when nuts were plentiful, agents traveled through the country districts and bought them in large quantities for shipment to the centers of consumption.

Of late there has been an increasing interest in the growing and marketing of both exotic and native nuts, and active steps have been taken to improve existing varieties and introduce new ones. By thus insuring a steady supply of first-class nuts new uses for them have been found, and growers are now reasonably assured of a steady and growing demand for the fruit product of the chestnut tree.

The American Chestnut.

Castanea dentata, Marsh.

The generic name Castanea was probably derived from Kastanea, a city in Pontius, Asia Minor, where the chestnut is a native, or from the town of Castanea in Thessaly where it is believed it was first brought into Europe. Some botanists affirm that the European chestnut is indigenous to the British Isles and the continent of Europe; but most authorities agree that it was introduced into Greece from Asia Minor, thence carried to Italy by the Romans, whence it was disseminated throughout Southern and Western Europe. Its introduction took place so long ago that chestnut trees have been growing apparently wild in Spain, Italy, France, and Great Britain for centuries.

The history of the European chestnut has been noted somewhat carefully because it is a question whether the American nut is worthy of a place as a distinct species, or is only a variety of the European. From a purely botanical standpoint there is little difference between the two, yet the pomological variations are so marked that certain authorities give the American nut specific rank on this basis alone. De Candolle, Asa Gray, Apgar and Loudon hold to the opinion that the American chestnut is but a variety of the sweet chestnut of Europe. Prof. Sargent and Mr. Sudworth, on the other hand, prefer to dignify our chestnut as a distinct species. The most

striking characteristics which distinguish the native from foreign chestnuts are found in its taller, straighter trunk, less rounded crown, thinner, smoother and more pendent leaves, and smaller, but, invariably, sweeter nuts. The differences in all cases are slight; hence, in this discussion we shall be as patriotic as possible, and follow the nomenclature of the school which regards our chestnut as a distinct species.

The specific name *dentata* was determined by Mr. Sudworth to be the earliest name identifiable with it, and by this it is generally designated. The Indians of New York State called the chestnut " O-heh-yah-tah," which meant prickly bur.

Castanea is distinguished by its broad spreading habit when grown in the open; its long, sharp-pointed, coarsely serrate bright green leaves; and its wealth of creamy-tinted, fragrant catkins, which burst into bloom in midsummer and give color to the landscape long after the apple and cherry trees have scattered their petals to the winds, or the red maples have matured their keys and the elms their samaras.

The staminate flowers are borne in the axils of the alternate leaves, on cylindrical catkins six to eight inches in length, which appear only after the leaves are nearly grown in June. The male flowers proper appear in 3 to 7 flowered cymes in the axils of minute bracts on the rachis of the pendent ament. The pollen is abundant and fragrant, and is liberated readily, so that wind fertilization is easily effected.

The pistillate flowers appear singly or in groups of two or three within a short-stemmed involucre of closely imbricated green bracts, in the axil of a bract borne on the base of the erect pistillate ament. This involucre grows rapidly and eventually develops into the bur which incloses the nuts. At the time of blooming the female (pistillate) flowers, including their burs, are about half an inch long, and are borne on stiff spikes that grow from the axils of the leaves of the newly-formed shoots. Usually only 3–4 flowers at the base of the spike produce fruit. The lower part only of the shoot supporting the immature burs becomes woody, as the portion beyond shrivels and drops off, leaving the burs at maturity as a terminal cluster. Botanically the fruit is a hard prickly cupule (bur) which splits at maturity into four valves.

Just what the bur of the chestnut is has puzzled botanists not inconsiderably, and remains yet an undecided question. It is thought to be a whorl of metamorphosed bracts.

The chestnut is strictly monoecious, yet in most individuals the staminate catkins mature before the pistillate, thus making cross fertilization a necessity. Why

STAMINATE AND PISTILLATE FLOWERS OF THE PARAGON CHESTNUT.

CHESTNUT BURS SPREAD ON THE GROUND TO DRY.

this provision is necessary in trees which produce perfect flowers of both sexes on one individual is a problem for the evolutionist; while to the arboriculturist the fact is significant only in that it shows him that his chestnut trees should be grown in groups and not singly in order to secure a full crop of nuts. In growing the various native and exotic varieties many advocate a mixing of varieties as well as of individuals.

Few long-lived trees equal, and none surpass, the chestnut in rapidity of growth and ease of propagation under ordinary conditions. In New Jersey* a chestnut tree is recorded which had a diameter of 60 inches at the age of 70 years, and which in one year increased its diameter by 1 inch. In the same State several trees 35 years old ranged from 24 up to 34 inches in diameter, with a height of 40–50 feet. The rate of growth is governed to a great extent by the nature of the soil, the thinner soils being less favorable to rapid tree growth than the deeper red sandstone lands. The above figures are remarkable, for the average growth of the chestnut is probably not over one-half as rapid. A diameter of 8 inches at 20 years and 12 at 30 is what may be reasonably expected as fair. Coppice should give trees of a size suitable for cross-ties and telegraph poles in 25 to 35 years, and large enough for posts in 15 to 20 years.

Our native chestnut is broadly distributed throughout the Eastern United States, and is found at varying elevations from sea level in Massachusetts, to 4,500 feet in the mountains of North Carolina. It occurs also on soils of very diversified nature, from almost pure siliceous sand to coarse, gravelly soil or shale, or even on limestone; on the latter, however, it is found only when the strata of the underlying rock is tilted. In general the dry rocky land of the glacial drift is preferable to the richer, more compact alluvial soil of low lands. The soil best suited for its growth is a retentive clay containing some sand. The tree does not require a rich soil.

In its more definite geographical distribution the chestnut is found from Southern Maine southward through New England; most abundant in the valley of the Merrimac River south of Concord, and in the Connecticut valley as far north as Windsor, Vt.; common in Massachusetts, Rhode Island and Connecticut, and along the coast as far south as Delaware, except where exposed to the direct winds from the sea. In Canada it is common in the Province of Ontario. In the Middle States it is common in New Jersey, Pennsylvania, Southern New York and parts of Maryland, and southward it is found all along the Alleghany Mountains to Alabama, and westward to Michigan, Indiana and Tennessee.

The chestnut tree attains its greatest development in Western North Carolina

* New Jersey Geological Survey. Report on Forests. 1900.

and Eastern Tennessee, where specimens 13 feet in diameter and 120 feet high have been found. This size, however, is exceptional. The average size at maturity in regions of favorable growth is a height of 60 to 80 feet, with an average diameter of 5 feet, although much larger specimens not infrequently occur. Near the northern limit of its range, which is about 44° latitude in the United States, the tree is decidedly smaller and sprouts less readily from the stump than farther south.

During the tertiary period Castanea flourished from Greenland and Alaska, and traces of it are found in the miocene rocks of Oregon and Colorado.

In New York the chestnut is plentiful throughout the valley of the upper Hudson, in Saratoga, Warren and Washington Counties, and along the slopes of the foothills belonging to the Catskill uplift. It has not been observed anywhere on the northern Adirondack plateau, and is scattered only sparsely throughout the western portion of the State. In the Adirondack region it is too cold for the chestnut to mature its annual shoots, but in the western part of the State its sparseness is due rather to unfavorable soil conditions than to climatic variances, the rich alluvial soil of Western New York being little suited to its best development. The tree attains its best development in that part of the State between the Delaware River and the Catskills, along the glacial hills which are a continuation of the Kittatinny Mountains and the northern " Jersey Highlands," a country famous for its oak and chestnut. This region, although well settled and cleared, is dotted by many large wood lots, and here lie most of the New York " chestnut hillsides," in which, because of their small value for other purposes, lie the opportunities for the profitable chestnut culture to be described later. In Saratoga and adjoining counties there also exist splendid possibilities for chestnut orcharding.

Within the limits of its range the chestnut occurs either singly or in scattered groups or groves, usually most abundant on the high, gravelly, well-drained land of hillsides and ridges, seldom growing in pure stands, but usually mixed with oaks or other hardwood trees. It has been stated on good authority that the " chestnut is almost unknown on red shale land ; " but in Central Pennsylvania it is certainly found growing well on almost typical red shale soil.

Groups of young seedlings are found only in the pasture lands or open forest, where there is plenty of light, since, as the chestnut when young is essentially a light-needing species, it cannot grow in the lower story of a high, dense canopied forest. The mature tree is moderately shade enduring. The chestnut is further handicapped in its struggle with more tolerant species, by its characteristic trait of not unfolding its leaves until most other trees are in full foliage, thus giving the earlier trees something of a monopoly of the available light and space.

Forest, park, or pasture-grown trees differ widely in general form and habit. The tree of the woods, because of its crowding neighbors, soon loses its lower branches and is stimulated to thrust its crown upwards towards the light, where it remains supported by a long slender trunk, which is the form most desired for telegraph poles, cross-ties, and the general uses of the lumberman. In fact it is a natural characteristic of the chestnut when grown in mixtures to shed its lower branches quickly, and develop a smooth, straight bole. When grown from stump sprouts several of these tall, tapering trunks are often found with their bases touching or even united, and all the product of one stump.

Started in the open and given plenty of room in which to spread itself in all directions, the chestnut devolves from its tall slender habit and forms a tree noted for its short stable trunk and broad spreading crown. Upon a short trunk, 4 to 8 feet in diameter, is often supported a crown from 40 to 60 feet high, with a spread of branches equaling, or often surpassing, the tree in height. Many of these spreading pasture trees rank among the most magnificent specimens of arboreal growth which are found in the Eastern States, and to a man who has spent his childhood in the freedom of the country the sight or recollection of these "spreading chestnut trees" will awaken in his mind many happy memories and associations of those blithesome, unappreciated boyhood days of long ago.

The exact extent to which the native chestnut has been improved by cultivation and extended beyond its natural range by artificial propagation is rather hard to determine. Certain it is, however, that experiments along this line have not been very comprehensive, nor the results sufficiently encouraging to warrant their continuance. American horticulturists and nurserymen are not slow to follow up a line of work which promises even mediocre returns; hence, the mere fact that our chestnut has received little attention from them is in itself proof that its cultivation as a shade or nut-bearing tree is not exceedingly profitable. This refers only to the wild native chestnut, and not to the improved or acclimated foreign varieties.

In the South nothing has been done further than utilizing for timber the magnificent chestnut trees of the Appalachian Mountains. In the North and West half-hearted attempts, with fair success, have been made to extend its range in the suitable soil of mountains and hillsides just beyond the range of natural growth. When carried too far north the new shoots fail to ripen before they are nipped by the early autumn frosts. On stiff alluvial soils the trees make a fair growth, but are short-lived and fail to produce fruit abundantly. It is thought that the presence of lime or alkali in much of the prairie soil is responsible for the poor growth. On very rich soil the growth is too vigorous and the tree is liable to be unproductive

and winterkill. More potent than extremes of heat and cold as sources of injury to the chestnut are hot dry winds, and in its susceptibility to them is found, perhaps, the principal reason why it will not thrive on the western plains and prairies.

In New York the region of growth can be extended northward towards the St. Lawrence Valley between the western edge of the Adirondack Mountains and Lake Ontario, and westward to the boundary of the State. The region of most favorable growth is from the southern boundaries of Herkimer, Hamilton and Warren counties in the Southern Adirondacks, southward to Pennsylvania and New Jersey. In the southeastern corner of the State the chestnut is decidedly at home and can be grown successfully in almost any part. The western half of the State, because of its lower elevation and less favorable soil, does not offer such a promising field for planting or grafting operations; yet even here the rough hillsides offer opportunities which should not be slighted.

The chestnut is reported as growing well under cultivation as far north as Saco, Maine; in Central Vermont; westward to Michigan, where plantations have been made by the Lake Shore and Michigan Southern Railroad along its right of way; and at several points in Wisconsin. In most of the Central and Southern States attempts to grow the chestnut have proved unsuccessful.

Despite the fact that our native chestnut does not possess the qualities which make it pre-eminently desirable from a pomological standpoint, it should not be overlooked that as a forest timber tree, to be grown as such, it takes high rank. The wood for railroad ties is considered almost the equal of white oak, and about five per cent of the ties used are of chestnut, while for fence posts and telegraph poles it has no eastern rival except the white cedar. Its rapid growth and tendency to reproduce by coppice makes it an exceptionally valuable tree for these uses. It reproduces readily from seed as well as coppices. The seeds, immediately after they ripen in the fall, may be planted in the places where the trees are to grow permanently, or they may be layered in damp sand during the winter for nursery planting in the spring. If planted in a nursery the trees should be transplanted at the end of the first year to the permanent plantation. Planted in mixtures with the white pine and red pine the chestnut is a most excellent species to use in reforesting the waste lands of Southern New England and New York.

To summarize, under the head of the "American Chestnut" it may be said that on the whole the attempt to improve its quality by cultivation, and its range by planting or transplanting, have proved unprofitable. The nuts produced are too small, and the time required for a tree to come into bearing too long to induce a hustling American to grow it for the nuts alone. Its greatest value for nut culture

lies in its root sprouts, which furnish most excellent "stocks" upon which to graft the most desirable European varieties. As a shade and timber tree, or source of nuts for home or local consumption, it will always hold an esteemed place with the American farmer; but the horticulturist or orchardist who wishes to produce nuts on a large scale must turn to the larger, more rapid growing European and Japanese varieties, or greatly improve the native nuts if success is to be assured.

With commendable and characteristic American energy horticulturists long ago began experiments with imported chestnut seedlings and nuts, so that now, at the time when conditions seem ripe for extensive commercial planting of nut-bearing trees, there will be no need in choosing varieties or in growing scions or seedlings, as the nurserymen have the problem well worked out, and can supply the increasing demand for the best Japanese and European chestnut trees which have been produced up to date. The complete history of the introduction of exotic chestnuts in America is a long one, and can only be briefly summarized here.

The European Chestnuts.

It would be neither safe nor advisable to attempt to give the exact date at which seedlings or nuts of the European chestnut, or "Spanish Chestnut," as it was popularly called, were first planted in American soil. Certain it is, however, that the introduction took place nearly a century ago, and that imported trees have been bearing fruit in this country for over fifty years. It was in the region around Philadelphia, Pa., Wilmington, Del., and Trenton, N. J., that the first general introduction took place, and from here has occurred the eventual dissemination of the different varieties to other parts of the country.

The initial introduction of foreign nuts was not, as would be expected, the work of horticulturists who wished to propagate them for economic purposes, but the result of efforts made by wealthy individuals to secure rare and interesting trees adapted for planting on their new world estates. To the French "Marrons" is accorded the credit of being among the first to introduce the European chestnut. Irenee Dupont, the founder of the now famous powder mills bearing his name, was a recipient as early as 1802 of chestnut seed and young trees from France. Most of the seed failed to grow, but records show that a few trees became established in his garden, and flourished for years, no doubt serving as a center of distribution for the surrounding country.

Although the non-professional tree growers took precedence as to point of time, it was the nurserymen who inaugurated the first systematic work of introducing and

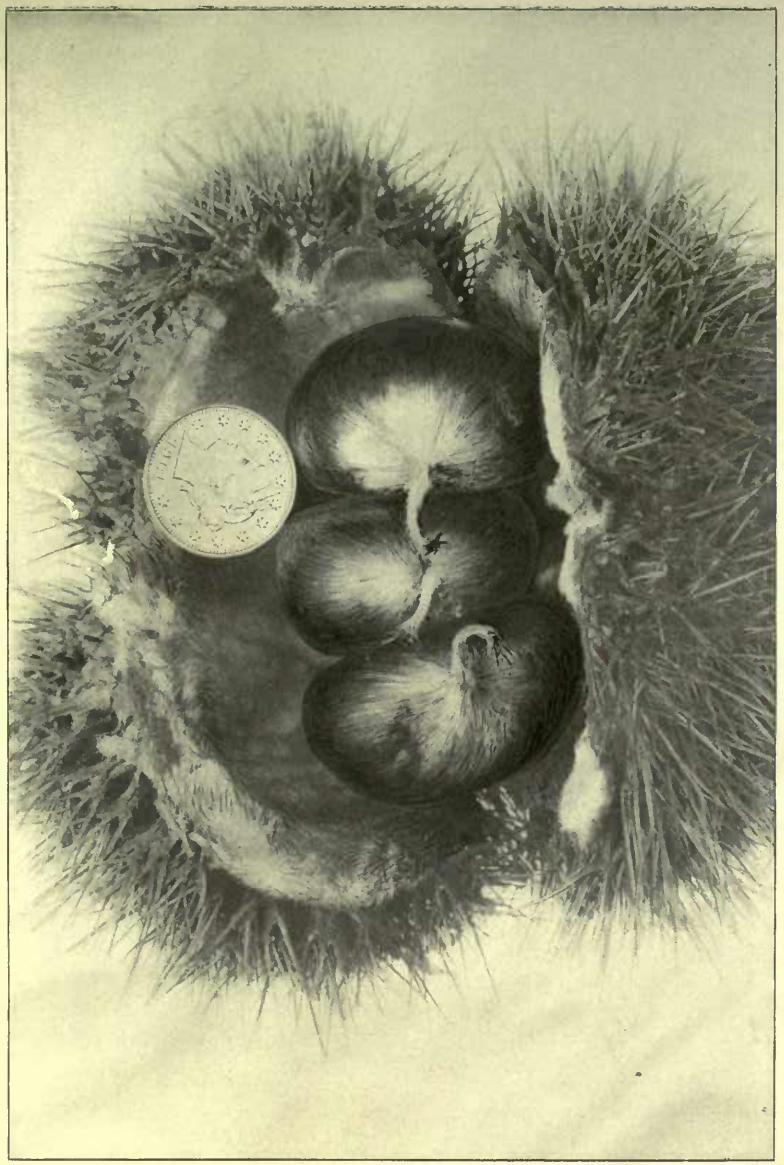
improving foreign varieties of chestnuts. Most of these men lived and carried on their experiments within a radius of fifty miles of Philadelphia. For some years there was a mania for importing trees and nuts, and each importer expected to find the one tree which would be par excellent for this country; but the failure on the part of most of the imports to withstand the change of climate eventually curbed the interest and checked the importation.

The chestnut will not grow true to seed, but often it varies only slightly; hence, selected nuts of both foreign and native varieties were frequently planted in the hope of securing from the seedlings a nut in which large size and good quality would be combined, and which at the same time would be able to endure the vicissitudes of our climate. In most cases the attempts resulted in failure, although in a few instances desirable trees were secured. The same was true with the many imported seedlings. The greater number of the imported trees proved frost-tender, and otherwise unsuited for their new environment. Of the large number planted probably not over one in a hundred has been retained as possessing desirable characteristics. Good quality rather than quantity in the acclimated varieties seems the most difficult to obtain. Trees which bear large sized nuts in abundance are many, but few of them produce a finely flavored nut. The European nuts are usually less bitter and astringent than the Japanese; but neither of them can approach the small native nut in sweetness and delicacy of flavor. The nurserymen have still before them the task of producing by judicious selection and crossing a large nut of fine quality.

A large number of European varieties are listed by nurserymen, but the experience of practical growers indicates that only a small proportion of these are worthy of propagation. The best are:

PARAGON.

Undoubtedly the best variety for general planting produced up to date. The original tree, according to Thomas Meehan, was grown by W. L. Shaffer, of Germantown, Pa., from a nut produced on one of the old Spanish trees growing in a Philadelphia garden. H. M. Engle, of Marietta, Pa., was the first to discover its exceptional value, and by him it was first grown extensively and introduced to the public. It is the variety now exclusively grown by Mr. C. K. Sober, of Lewisburg, Pa., who owns a promising grove of 300 acres near Shamokin, Pa. The nuts are large, three-fourths of an inch in circumference, and somewhat pubescent. One average specimen will cover a silver dollar, while thirty-two selected nuts will weigh one pound. The tree is hardy within the range of the native chestnut, ripening moderately early in Central Pennsylvania about October 1, comes into bearing very



PARAGON CHESTNUTS — NATURAL SIZE.

THE FIVE CENT NICKEL COIN IS SHOWN FOR COMPARISON.

NATIVE. PARAGON.

young, and is exceedingly prolific. In fact, the young trees are such heavy bearers that it is almost a drawback to their value, as they will exhaust their vitality and die, or lose their vigor of growth if unrestrained.

Paragon grafts take exceedingly well in American stocks, and have been known to grow well when grafted upon red oak sprouts. While not free from insect attacks the Paragon is much less affected by the weevil than are other varieties.

A not serious reduction of its many good qualities is the tendency of the burs to remain closed and fall to the ground with the nuts still retained. They open readily, however, if spread in the sun; hence the only detriment is a slightly additional cost in harvesting. It saves, on the other hand, however, the loss and difficulty occasioned by picking the nuts from the grass and debris beneath the trees. For planting in this State the Paragon can be safely recommended above all others.

Numbo.

Bur medium; nut large, bright, slightly pubescent and of excellent quality. It is extensively grown, and is deserving of second place in the list of valuable varieties. Its greatest fault is that it is not sufficiently prolific.

The original Numbo seedling is a vigorous tree still growing on the nursery grounds of Mr. S. C. Moon, at Morrisville, Pa. At present it is a tree with a diameter of about three feet, and a rounded symmetrical crown with a spread of branches of about 60 feet. The history of the Numbo, as given by Mr. S. C. Moon, is that it is one of the seedlings imported from France or England by his father, Mahlon Moon, about 1850. Of a large number imported, both at this time and later, this tree turned out to be the best one of the few good ones which were retained. Many scions have been taken from it, and the Numbo is now known and grown in various parts of the Middle States. It is not a Japanese seedling, as many suppose, nor is Numbo a Japanese word; but is rather an abbreviation of the name Magnum Bonum, which the elder Moon first applied to the variety.

Ridgely.

Bur medium, nut smaller than Paragon and less pubescent at tip. The skin is astringent, but the flavor of the nut is good. The tree is hardy and a very prolific bearer. The original seedling was sprouted by Irénée Dupont, Wilmington, Del., and sent to Henry M. Ridgely about 1822. Because of its hardiness it is worthy of experimental propagation in New York State. It bears a very large nut, bright in color, and of attractive appearance. It is a very heavy producer and is among the

earliest to ripen. Because of its beauty and earliness it brings a high price in the market, and should be grown in quantities sufficient to supply the early demand.

The Japanese Chestnuts.

The Japanese chestnuts are of more recent introduction than the European; but from the limited experience with them it seems certain that they are a valuable acquisition. The limits of the range to which they are adapted is uncertain; it seems probable that their distribution may comprise the area covered by the American chestnut. Judge Andrew J. Coe carried on experiments some years ago, near Meriden, Conn., which seem to show that Japanese varieties are hardy in this part of New England. In low land where frosts were very severe he grafted several newly imported varieties upon native stocks, and found that they not only made a close union and rapid growth, but were uninjured and bore well after frosts of unusual severity.

Compared with the American and European varieties the Japanese chestnut is a smaller tree,— a semi-dwarf, with a compact crown, slender branches and small buds, apparently, though not actually opposite. The leaves are long, narrow, usually pointed, with sharp teeth and a white tomentum underneath. At a short distance the tree is quite peach-like in appearance. The burs are small, thin, with large nuts, free from pubescence; but the meat is covered with a bitter skin, which should be removed before eating. Are very early to ripen. The nuts are of poor flavor when raw, but excellent when cooked. The foliage is comparatively free from the common leaf fungi, making the tree very desirable for ornamental planting. Will probably succeed better south than north.

The wood is rather slow growing, but Japanese scions have a close affinity for American stocks, and hence take well when grafted. It has been asserted that because of this affinity they are more desirable for grafting on American stocks than the trees of European derivation. This has been found to be an unjust criticism when comparing the two, because the best European varieties, of which the Paragon and Numbo are fair samples, take readily on American wood.

In New York the grafting of Japanese chestnuts on native stocks has been reported as successful in Washington and Yates Counties. In Rockland County both whip grafting and budding have given fair results.

The first introductions were the outcome of efforts made by several nurserymen to find and naturalize valuable Japanese seedlings. The climatic conditions of parts of Japan are not widely different from those of the Eastern United States, and as

other trees and shrubs had been introduced successfully, it was inferred that the chestnut could be added to the list. The first recorded importations were by Mr. L. B. Parsons, of Flushing, N. Y., in 1876. These trees received very little care, but, nevertheless, grew and soon came into bearing. In 1882 the late William Parry, of Parry, N. J., began their importation on a large scale, and has done much toward improving and disseminating the best varieties. Probably no one has done more to arouse interest in chestnut culture and put it on a commercial basis than Mr. Parry. For years he was engaged in importing chestnuts, propagating new varieties and improving the old, and several valuable varieties have originated in his nurseries. Mr. J. T. Lovett, of Little Silver, N. J., also imported trees and nuts extensively in the earlier '80s, and has produced several new varieties. He now prefers European varieties, however, and has at Emilie, Pa., a fine Paragon orchard of about 1,200 trees from four to thirteen years old.

The number of Japanese varieties offered by nurserymen is very large, but are much confused as to nomenclature, because of the distribution of seedlings under various good selling names, such as Mammoth, Giant, etc. Those recommended as of tested value are the following:

Alpha.

First in importance as well as name. Originated by William Parry, of Parry, N. J. Claimed to be the earliest known variety of chestnut, and especially valuable on this account. Ripens at Parry, N. J., about September 10. Tree an upright, vigorous grower, and very productive. The original tree began to bear when three years old, and has never failed since to produce a full crop. Burs rather small, somewhat flattened; spines thick, short and stiff; nuts large, averaging two or three to the bur. Quality only fair, but it commands a high price in the market because of its early appearance.

Reliance

Another one of Parry's seedlings. Tree a semi-dwarf, low spreading and drooping. Comes into bearing remarkably early. Scions not infrequently mature fruit the first year they are set. This should not be allowed, however, as the early bearing injures the future vitality of the tree and reduces the size of the nuts. Burs medium, with three to five large nuts to the bur. Ripens from September, 20 to October 1, in New Jersey.

Hale.

Originated from seed imported in 1886 by Luther Burbank. Now grown by J. H. Hale. Tree low, of spreading habit, with narrow pointed leaves of a very

glossy dark green color. Burs with thin peppery shell, each normally containing three nuts of medium size and rich brown color. Is very prolific, and, from experiments of Hon. Andrew J. Coe, in Connecticut, very hardy.

PARRY.

One of the best productions of the Parry nurseries. It is the original "Parry's giant," also called "Japan giant." Tree large for a Japanese chestnut, open, spreading, very prolific and an early bearer. Burs very large, containing usually one, sometimes three nuts. Nuts largest known, sometimes two inches across; ridged; bright mahogany color, and of fair quality. If exceptionally large nuts are desired this is the variety to plant.

To attempt a close discrimination based on the general qualities of the Japanese and European varieties of chestnuts is rather difficult because both groups have many good qualities, and each, unfortunately, several bad ones. For each, too, can be found men who earnestly advocate the propagation of their favorite group to the exclusion of the other; hence, to favor one is to produce enmity. The difficulty is that few growers have experimented with more than a few varieties of each group, and they are inclined to make sweeping assertions on a limited experience.

If the general characteristics of each group, as far as known, be listed and compared the balance of favor would give the Japan nuts first place. If, however, the two or three best and most widely grown varieties of each be compared, the imports from the far East are immediately reduced to second place. The experience of practical growers corroborates this view, and men who were once heavy importers of Japanese seedlings are now planting only European trees in their commercial orchards. When the Oriental varieties were first introduced it was thought they would be the money makers in either groves or orchards; but to-day it is hard to find them grown on a large scale.

As an ornamental tree the Japanese chestnut is of undoubted value because of its freedom from disfiguring fungi and insects, and its large beautiful nuts. From the purely financial standpoint, however, as well as for horticultural reasons, the more enduring, better flavored European varieties are to be recommended for extensive propagation in New York and the Northern States. It is advisable, nevertheless, for all growers to experiment to some extent with varieties of uncertain value, so that they may find the ones best suited to their local conditions.

Systems of Management.

Two distinctive methods of chestnut culture are in vogue in the Eastern United States. The one is the method of grafting young native chestnut coppice (sprouts) with the scions of Japanese, European, or native varieties, and depending on the roots of the old stump, and the new roots which are developed, to afford nourishment and give the necessary mechanical support. Where the natural stump sprouts are thus grafted the resulting growth is called a "chestnut grove."

The other method is to grow young plants from seed, graft them in the nursery when two or three years old and the following year set them in orchard rows in cleared or cultivated ground. When nursery seedlings are cultivated in this way they are described as a "chestnut orchard."

The propagation of chestnuts in groves by the grafting of numerous young sprouts is decidedly the most advisable, both from an economic and purely horticultural standpoint, in a country where native trees are at all common. If only a partial stand of sprouts can be obtained, they should be encouraged and grafted, and seedlings planted in the blank spaces between, other species of course being cut out.

The grafted sprouts by virtue of the old established root system are furnished an abundant supply of nourishment and make a surprisingly rapid growth, often bearing fruit profusely when only three or four years old. One little Paragon graft in Mr. Sober's grove matured 56 large burs when only two years old. Trees three to five years old bear several pints of nuts annually, while their crop when more than five years old may be counted in quarts. Paragon grafts when ten to twelve years old produce on an average a half a bushel or more of nuts. With a chestnut grove there is, too, less liability of failure in obtaining a full stand of trees, as the loss attendant upon transplanting is eliminated, while the great number of sprouts which spring up in a newly cut-over chestnut forest gives an abundance of stocks upon which to graft the scions. With experienced men there is little loss in the grafting process, and under favorable circumstances ninety per cent of the grafts may be expected to take. By grafting a large number of sprouts per acre there is sure to be left, after deducting for all probable loss, a thick stand, which may be thinned as conditions require, thus keeping the ground continually covered, and production, even at the outset, at its maximum. The newly grafted sprouts which are removed to make room for others furnish a fine supply of new scions, if cut in the late fall or winter.

The trees which are ultimately to cover the ground and produce the fruit should

not be allowed to mature burs while less than five or six years old; but since the original stand is to be thinned eventually, it is possible to mark, at an early date, those intended for removal, and allow them to fruit while young, thus securing early returns without working permanent injury to the grove.

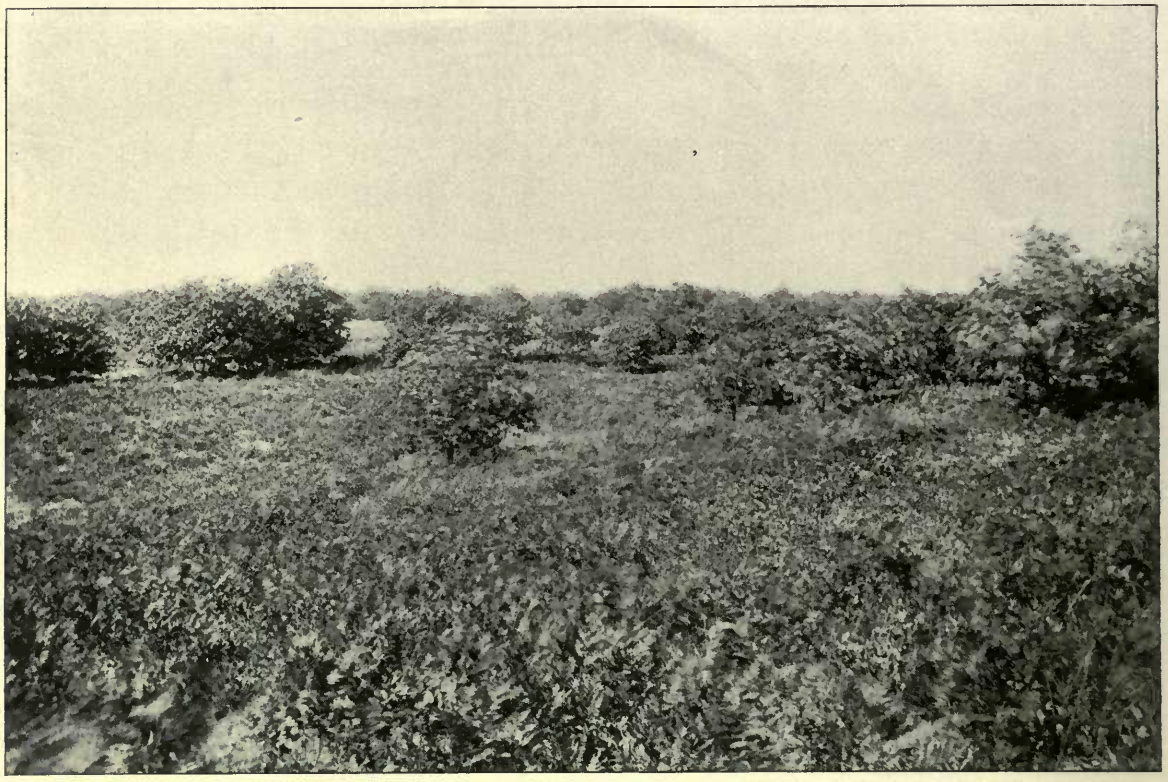
Financially the chestnut grove is to be preferred to the orchard for several reasons. First, the cost of cutting off the old stand and grafting the sprouts does not greatly exceed the expense of producing seedlings and grafting them in the nursery, and, in addition, the chestnut timber removed is usually of considerable value for fuel, poles or railroad ties. Secondly, the ground which produces the sprouts is usually of little value for agricultural purposes, being mostly rough waste land; while in setting a chestnut orchard land is required which would be of considerable value for general agricultural purposes. Thus the cost of the first investment is in favor of the chestnut grove rather than the orchard; hence, from the latter it would be necessary to realize a greater income in order to pay interest on the large capital tied up in the more expensive land. As a third condition there is an appreciable loss in time — and, hence, in revenue — in the chestnut orchard; because seedlings, especially when retarded by an early graft, do not come into bearing nearly as early as do the grafted sprouts. A vigorous stump sprout will be a tree eight to twelve feet in height when five to seven years old, and will produce several quarts of nuts annually. A grafted seedling does not attain this size, nor bear to the same extent until eight to twelve years old. The seedling, however, has the advantage of longer life and less liability of deterioration.

With the rough, idle chestnut hillsides and flats of New York, as well as other States, it is a question of raising chestnuts or waiting through a long period of years for the timber to mature. Even then the most desirable timber trees will not grow unless planted, so great is the power of worthless species to crowd out the more valuable ones. On the fertile soil of the plains or uplands where most of the chestnut orchards are located, it is a question of raising chestnuts, pears, apples or other common fruit; hence the loss in case the chestnuts fail is much greater. In the latter case chestnut culture becomes merely a branch of horticulture, to be governed by much the same rules as apply to apple and pear orchards. When the sprouts on a worthless old hillside are grafted and made to produce a valuable crop of nuts, as well as timber, the work is surely entitled to a place as a branch of forestry, since the essential elements of a tree forest are all present, and are preserved rather than disturbed. In addition it is an important step towards the solution of the great problem of reclaiming the worthless waste lands which at present are a menace to the surrounding forests, and which show a lack of the Yankee ingenuity that has

A YOUNG CHESTNUT "GROVE."

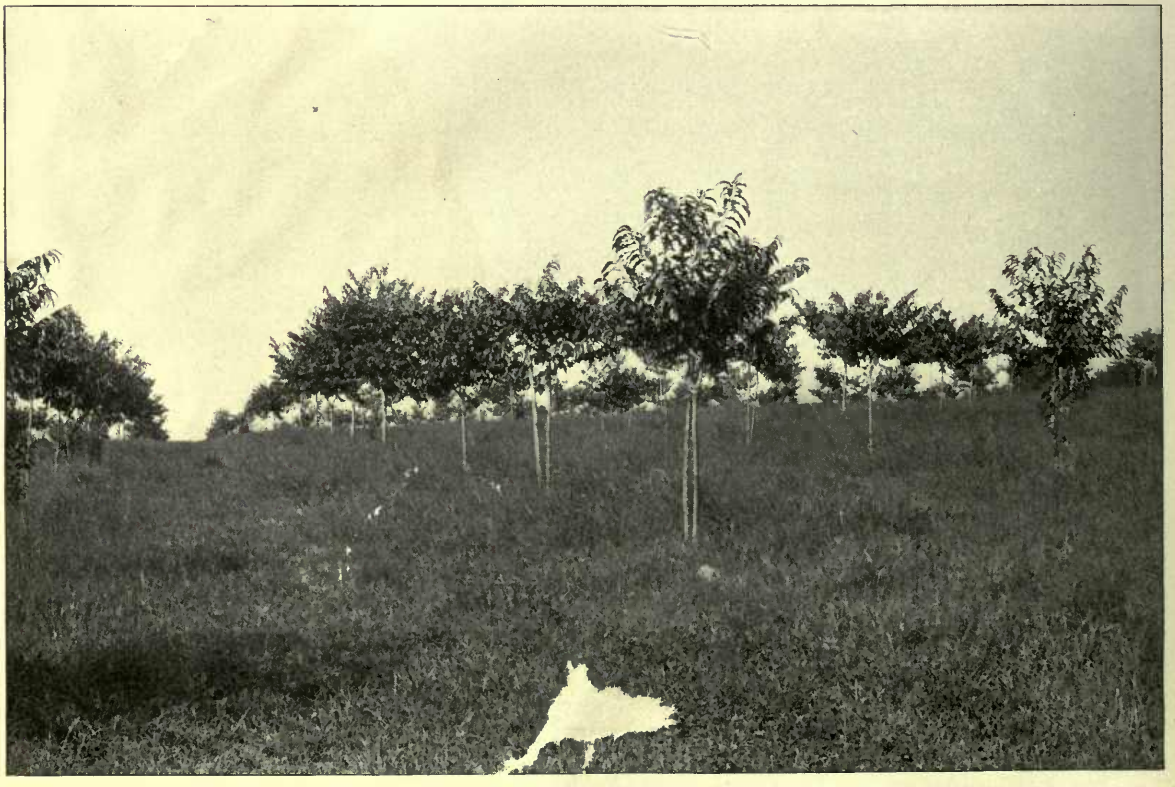
TREES SIX YEARS OLD. PARAGONS GRAFTED ON NATIVE SPROUTS.

DISTANT VIEW OF ONE OF MR. SOBER'S CHESTNUT GROVES.



GENERAL VIEW IN THE "GROVE" OF THE ALBION CHESTNUT COMPANY.

THE TREES ARE NINE YEARS OLD, MOSTLY NUMBOS.



A CHESTNUT "ORCHARD."

solved the problem of "complete utilization" in nearly every branch of commercial activity, except forestry.

The chestnut orchard, it is true, often has the advantage of location, accessibility to market, freedom from underbrush, and lessened danger from fire, while as an additional advantage the purely artificial orchard may be started in a region where the chestnut is not indigenous. To the man, however, who is after the largest returns in the shortest time, the chestnut grove, produced by grafting the coppice sprouts in the natural chestnut forest, provides the most. A combination of the two may perhaps be profitably effected under certain conditions.

The Chestnut Orchard.

Although chestnut orcharding in its extreme form is not considered as profitable as the grove system, yet the method of procedure is here briefly outlined for the benefit of those who wish to grow chestnuts and yet do not have the native sprouts upon which to start their scions.

The first step is the starting of the seedlings in the nursery. These may be grown from native or imported nuts, it being immaterial which so long as vigorous seedlings are produced. The seeds (nuts) may be planted in the fall or spring in nursery rows four or five inches apart in the row and covered one to two inches deep. Fall planting is advisable if the nuts can be protected from mice and squirrels. If planting is delayed until spring the nuts should be kept over winter, layered in damp sand. In one year they should have attained a height of six to twelve inches, and in two years stand two to three feet high. The third spring they should be grafted while yet in the nursery rows, and the following spring transferred to the orchard rows. Tongue or whip grafting is the most successful method. Budding, grafting one year olds at the collar, and root grafting as done with apple trees, have all been tried, but with little success. As a variation on the above, the two or three-year-old seedlings are sometimes first transplanted to the orchard rows and then grafted. This, however, results in a loss of time because the trees must be allowed to get their root system firmly established before setting the scions, otherwise they will not have sufficient vitality to withstand the shock of both grafting and transplanting.

The trees are usually set thirty feet apart each way; but with the smaller Japanese varieties they may be set as close as twenty feet. In the New Jersey orchards the ground is kept cultivated for some years, during which crops of corn or potatoes are raised between the rows. Mr. R. Williams, of Riverton, N. J., tried the

experiment of setting native seedlings, four to six feet high, in rows twenty feet apart, cutting back the limbs to the two-year-old growth, and inserting scions of Japanese varieties. The plan is not advisable because it makes the crown too high and heavy to be safely supported by the long slender trunk.

No case is known where grafted seedlings have been set in brush land. The first cost would be somewhat greater; but there seems no evident reason why such treatment would not be successful. If seedlings will thrive equally well in cultivated or brush land, one of the objections to chestnut orcharding would be removed. The long time element remains, however, an unchanging disadvantage in such management.

The Chestnut Grove.

Given a mixed stand of coppice chestnut and oak and other hardwoods, to transform into a nut-bearing grove of improved exotic varieties. The system applied in the best groves of Pennsylvania and New Jersey is practically as follows:

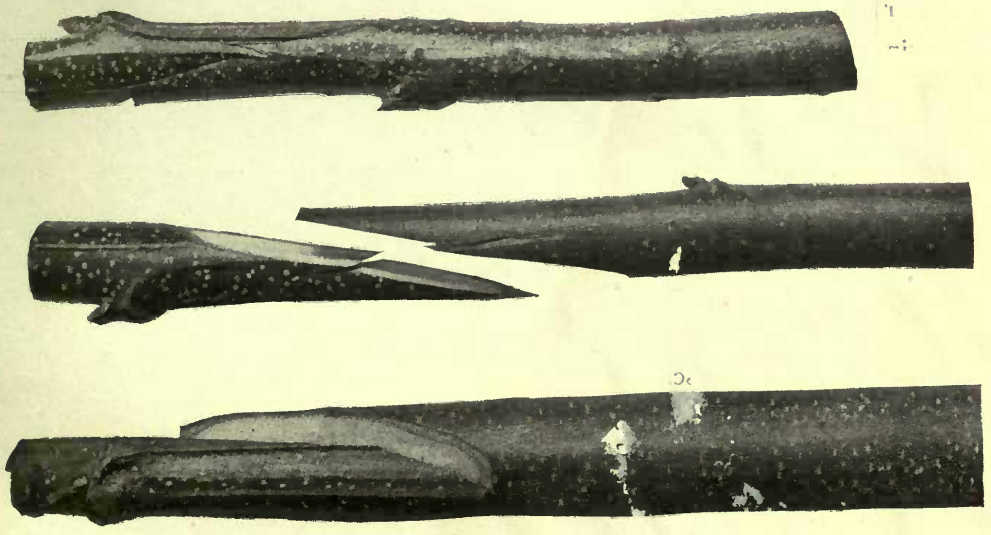
In the late fall or winter all trees and brush are removed from the area under management, care being taken to cut the chestnut near the ground and leave smooth stumps. From these stumps there will spring up during the following summer a vigorous growth of sprouts, usually several around each stump, which in one year reach a height of four to six feet, and a diameter from one-fourth to three-fourths of an inch at two feet from the ground. Experience has shown that sprouts of this size are the best for grafting; hence it follows that the second spring after the timber is cut off grafting operations may begin.

Grafting may be commenced when the buds first start; but it is better to wait a little later, until the sap flows freely. May is the best month in which to graft, although it may be commenced as early as the middle of April. The tongue or whip graft is the method which should be exclusively used. Budding, cleft (wedge) grafting, prong grafting, crown grafting and many other methods have been tried, but experience has shown that they are in general impracticable. The cleft or wedge graft can be set in stocks of a size up to several inches, and usually succeeds to the extent of making a union, but it seldom heals smoothly, and usually leaves an opening between the stock and scion which becomes a source of infection and point of structural weakness to the whole tree. With the small sprouts and the whip graft the union is seldom discernible after a few years.

The scions should be cut early and kept dormant in a cellar or ice house until the buds on the stocks are well swollen in the spring. It should be remembered

SPROUTS BEFORE GRAFTING.

THE PLACE WHERE THE SPROUT IS GRASPED BY THE FINGERS SHOWS THE HEIGHT AT WHICH IT SHOULD BE CUT OFF AND THE SCION INSERTED.



THE "WHIP" OR "TONGUE" GRAFT.

GRAFTS FOURTEEN DAYS OLD.

SHOWS METHOD OF WRAPPING WITH MUSLIN.

that the sap of the chestnut does not start as early as that of apples, pears and other succulent fruit, and hence grafting should be done later.

The stump sprouts should be cut off and the scions inserted some three to four feet from the ground, so as to keep the heads low. Where there is a circle of sprouts around a stump the ones which start nearest the ground should always be chosen, because they root in more firmly and are less liable to damage by the wind. In a group of sprouts, such as spring from one stump, only one or two are grafted; but the rest are left during the first year as a protection to the young grafts. Where sprouts are plentiful grafts should be put in every 12 to 15 feet or from 200 to 400 per acre, care being taken to leave no open spots or any unnecessary grouping. As the trees grow and expand the poor and crowded specimens should be removed to make room for the better trees. If small seedlings appear they should also be grafted.

Many mistakes have been made in grafting, and as it is a most important phase of chestnut growing, in fact, the basis of success, too much care cannot be given to this part of the work. If well done ninety per cent of the grafts should live. An experienced man should set 250 scions per day, and do it well. In whip or tongue grafting the stock and scion should be of as nearly the same diameter as possible, and the cut on each long and smooth and made with a thin, very sharp knife. Each should then be cut vertically so as to leave a wedge-shaped piece on the face of each cut, so that the tongue of the scion may be forced firmly into the cleft of the stock. The union should be exact, so that the inner side of the bark on each will coincide at least on one side. The joint should be thoroughly waxed, and as a further precaution wrapped tightly with waxed muslin. The muslin holds everything firm, thus hastening the union of the cambium layers. It excludes air from the cracks in the wax caused by the expanding sprout, and gives a mechanical support which prevents breakage of the joint by the wind. The yearly growth of grafts when thus treated is quite remarkable. When two months old they are often two to three feet in length, while it is recorded that one specimen grew in one year a linear distance of 54 feet, counting the main axis and all the lateral branches. The writer measured one graft which had been inserted 14 days and found it to be ten inches long. The first year's growth is inclined to assume a fan-shaped form, and not make a well-rounded crown; hence it has been found advantageous to cut back the first year's growth in the fall so that only a stub three to four inches long, containing two to three buds, remains. The following year these buds will grow into a well-rounded head.

An interesting fact is that many of the European chestnuts will grow equally

well if grafted upon oak sprouts or seedlings. In France and England the chestnut has been grafted upon the English oak (*Quercus robus*) for years. In this country the U. S. Division of Pomology found by experiments that several varieties of European chestnuts, including the Paragon, Numbo and Ridgely, grow well on our chestnut oak (*Quercus prinus*). In Central Pennsylvania the Paragon has been seen grafted upon red oak (*Quercus rubra*) with evident success. This adaptability of the chestnut to thrive on oak stocks materially increases its range and possibilities.

It is essential that a good grafting wax be used if success is to be attained. An excellent wax is the following from an original formula by Mr. C. K. Sober, Lewisburg, Pa.: Resin, 2 pounds; beeswax, 2 pounds; beef tallow, ½ pound. The whole to be melted together and worked into a wax upon cooling.

Another wax recommended by the U. S. Division of Pomology for nut trees is: Linseed oil or tallow, 1 pound; resin, 6 pounds; beeswax, 1 pound. Melt all the ingredients together, pour into water to cool, and knead into balls of convenient size.

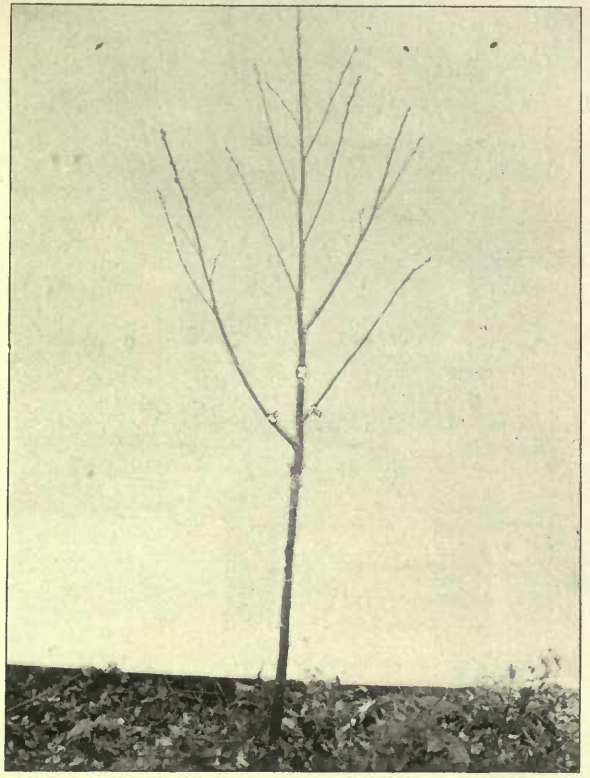
As to species it is hard to say anything definite, because local conditions so greatly affect species and the final results. The Numbo, Paragon and various Japanese varieties take well on American stocks. From the experience of the practical men in the business, and from personal observation, it seems, however, safe to recommend the Paragon as the best for general propagation in chestnut groves. With whichever variety is chosen for the main crop, trees of another variety should be mixed in so that cross-pollinization may be effected, although there is some uncertainty as to whether this is absolutely essential.

Harvesting.

With the exception of the Paragon the imported chestnuts have burs which open when the nuts are ripe, allowing them to fall to the ground, where they may be collected. It may be mentioned here that the frost performs no direct function in ripening the nuts, although there exists a widespread notion to the contrary. The process of ripening is gradual, and is usually finished before frosts occur. The part the frost really plays is in checking the growth of the tree, and thus causing the withdrawal of the sap from the twigs and burs. This reduction in moisture results in a shrinkage in parts of the bur; the outer, thinner, and more exposed portion drys more rapidly than the thicker inner part around and at the base of the nuts. It is this unequal shrinkage which causes the involucre to open. A long rain, followed by drying weather, is often equally effective in opening the burs.

THE BEST METHOD.

THE JUNCTION OF THE STOCK AND SCION IS WRAPPED WITH WAX AND MUSLIN.



TREE GRAFTED LAST SPRING (1902).

THE TAPES SHOW WHERE TO CUT IT BACK.

THE "WEDGE GRAFT."

A WRONG METHOD.

A "WHIP GRAFT" 21 YEARS OLD.

THE PROPER METHOD OF GRAFTING.

In the case of the Paragon the burs must be picked from the trees by hand, or, by waiting, they may be gathered from underneath the trees, as the closed burs soon fall. Ripeness is indicated by the yellow color of the bur, and a slight cracking open at the end, disclosing the nut within. The collected burs if spread in the sun a few days will open fully, and liberate the nuts.

Care of the Crop.

Having secured a crop of nuts the next step is their proper care and disposition. Those sold immediately need no special care, and from present indications prompt sale of a large crop will not be difficult. There is a growing demand for large, sweet chestnuts, especially in the Middle West, and dealers are usually on hand to buy up the crop even before it is harvested. Prices for the best nuts range from five to twelve dollars per bushel. On the streets of Philadelphia, Paragon nuts sell readily at forty cents per quart.

If not immediately disposed of the nuts should be subjected to some treatment to prevent their getting hard and being destroyed by weevils. Probably the best treatment is the scalding method. By this plan a quantity of nuts are put in a tub, or other water-tight receptacle, and covered with boiling water. If stirred for a few minutes the wormy, and otherwise defective ones, will come to the surface and may be removed and destroyed. The good nuts in the bottom should be allowed to remain for ten minutes, so that all eggs and larvæ may be killed, then removed and dried. Nuts thus treated will not get flinty hard when subsequently dried for winter use. Another plan is to put the nuts in cold storage as soon as harvested, removing them only as required for market. Those which are to be planted the following year should be treated with carbon bi-sulphide to destroy all insect life, and then layered in sand during the winter.

Uses.

Mention has already been made of the extensive use of chestnuts in many foreign countries, notably France, Spain, Italy, Korea and Japan. In all of these countries the chestnut is considered, not as a luxury, but as a staple article of diet, to be prepared and used as such. It is said that Paris alone consumes twenty million pounds of Marrons (table or desert chestnuts annually, while the consumption of nuts and meal in France as a whole is so great that, despite the enormous production within her own territory, several million dollars worth of nuts are

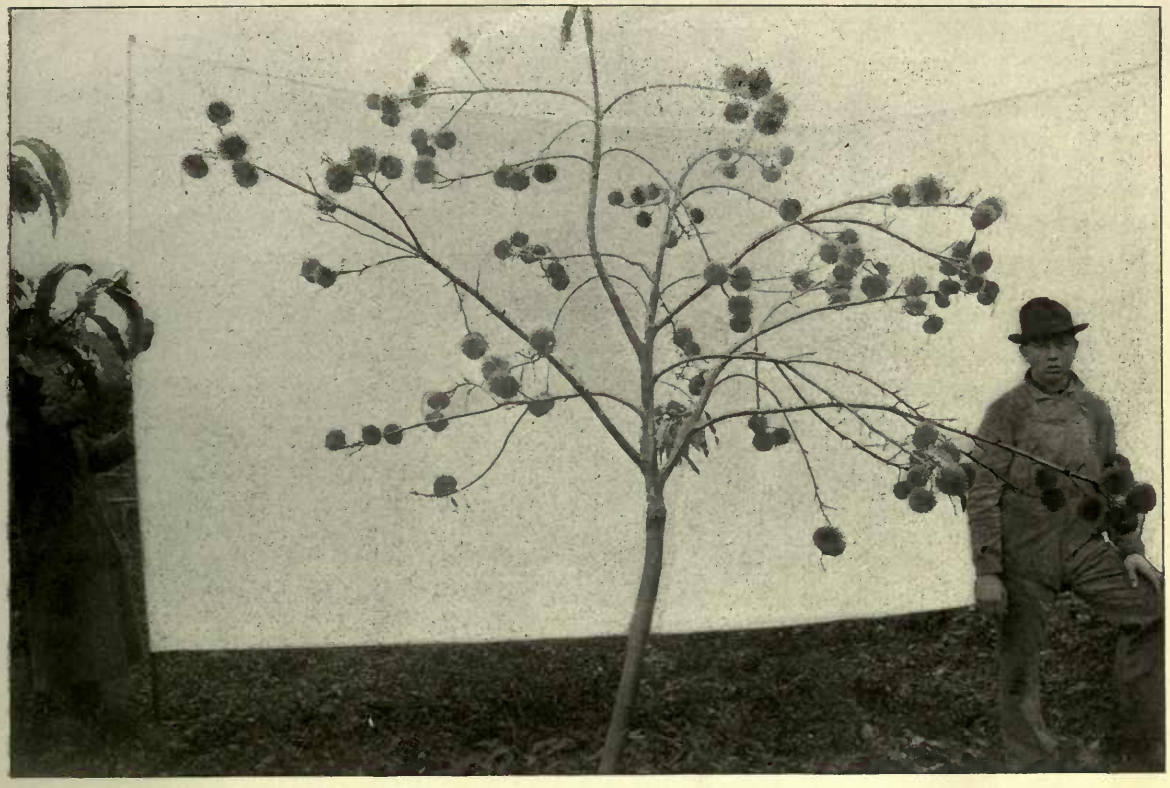
imported from Italy and Turkey yearly. Nor is the consumption confined to the peasant classes, who use the flour almost exclusively for bread; but chestnuts roasted, steamed, puréed, as a dressing for meats, and as vegetables, are served extensively on the tables of the rich.

In this country the variety of food stuffs is so great, and their production so easy, that necessity has never taught us the value of nuts as food. The great grain fields of the West are looked upon as the one legitimate source of the "staff of life," yet the fact remains that chestnut flour makes an equally palatable and a more nutritious bread. The chestnut when raw is not easy to digest; but in cooking the starch grains are broken up, making them readily digestible. Prejudice, coupled with ignorance and lack of appreciation of its good qualities, are the factors which to-day retard the adoption of the chestnut as one of our staple articles of diet.

In chemical composition and relative food value, the chestnut differs widely from other nuts, since it contains a large percentage of the carbohydrates, especially starch, and less proteine matter and oils. In this respect it quite closely resembles wheat flour. Since the carbohydrates are the chief source of the energy used in maintaining the vital processes of the body, it follows that the chestnut, by reason of its high percentage of these carbohydrates and the comparatively small amount of nitrogenous matter, is a better balanced and more nutritious food than other nuts, or even many of the cereals.

It may be that when the wheat lands become less productive and the margin of profit lower that men will turn to the idle, untilled woodlands of the East and utilize them for the production of nuts as a substitute for cereals. A change in our bread-making material, if ever made, will come slowly, since public taste and long-established customs are slow to alter, and new introductions are looked upon with distrust. The growing realization that the fine white bread in use at present is lacking in nutriment, and is injurious to the digestive organs, and the general crusade against it by physicians and health food advocates, will, however, rapidly turn public attention to new cereals or substitutes for them.

An acre of land will grow 35 bushels of wheat in a year if properly cultivated. A like area of chestnut trees will produce many times as many bushels of equally nutritious food yearly for an indefinite period, and require no outlay for cultivation, replanting or fertilization. More than this, the spring frosts, beating rains and summer droughts, which are a constant menace to a wheat crop, work no injury upon the chestnut tree or its fruit. Why then is wheat grown on millions of acres, while we fail to produce even enough chestnuts to supply the now limited demand, and allow Southern Europe to exact large tribute from us annually for the nuts we



FROM THIS TREE 300 YOUNG BURS WERE PICKED; 200 WERE LEFT ON THE TREE TO MATURE.

A NORMAL YIELD.

import for consumption in their raw, unwholesome form. With the exception of the occasional Thanksgiving turkey stuffed with chestnut dressing, chestnuts in their many appetizing cooked forms seldom appear on the bill of fare of the American people; and yet housewives are constantly complaining of the lack of variety in the foods obtainable. Why not try chestnuts? Mrs. Rorer gives several excellent recipes which any cook can follow or enlarge upon at will. If given a fair trial the chestnut cannot fail to commend itself for general table use, and when once generally introduced new uses for it will be found, and its permanent place among our valuable food products assured.

Insects.

Enemies in the form of fire, thieves, or wind may be fought and controlled, either wholly or in part; but when we consider the insect pests in their relation to chestnut culture, a more serious problem presents itself. Insects are so subtle in their workings, so mysterious in their many forms, and present such vast numbers, that man with his limited powers must stand more or less powerless in the event of their extended ravages.

The chestnut as a tree is not seriously injured in either leaves or trunk by any form of boring or defoliating insect; but unfortunately the nuts furnish a breeding place and food supply to a very destructive larva known as the "chestnut weevil." So great has been the destruction wrought by this weevil in parts of the country, especially in the South, and on the more susceptible varieties, that many growers have ceased the commercial propagation of the nuts because of the annual reduction of profits by the ravages of the weevil. It must be admitted that the tribute of one-half to three-fourths of the crop, which weevils sometimes levy, is decidedly discouraging; but these extreme cases are usually the result of unwise choice of species, or an unfavorable location of the grove or orchard. Improved varieties suffer most in or near native chestnut forests. Japanese varieties suffer less than European, and of the latter the Paragon is least affected. Insect pests on apple, peach and other fruit trees have been controlled, and it seems reasonable to suppose that if chestnut culture assumes sufficient proportions, remedial measures will be found for the chestnut weevil.

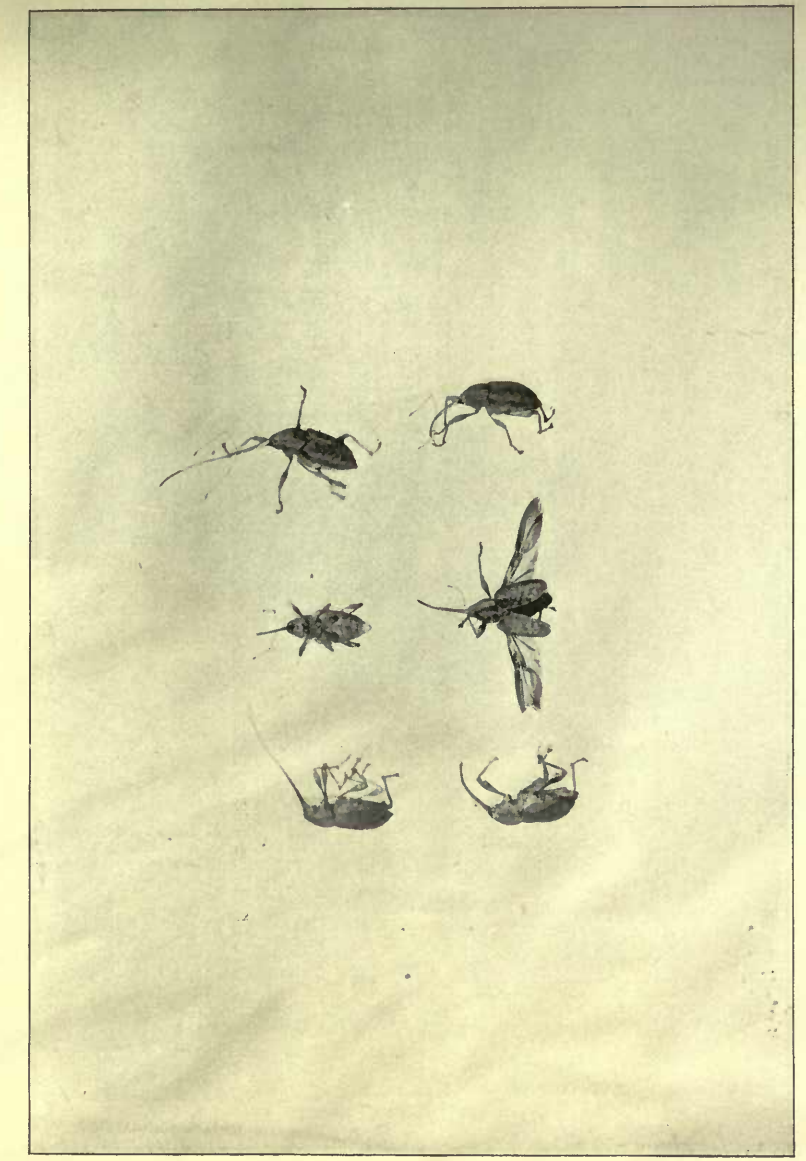
At present the danger of an annual diminution of profits from wormy nuts is the one drawback to extensive culture of improved chestnuts, especially on cut-over chestnut land. The control of this pest is a question of vital interest to growers and entomologists, and upon its proper solution depends, to a great extent, the ultimate success of chestnut culture on waste land. With the Paragon and other

varieties which are least susceptible, the margin of profit left after the worms destroy a considerable portion of the crop is sufficiently high to induce many to invest in the business, even when possessed of the certain knowledge of this annual loss. If this damage by weevils can be decreased or made nil, the profits, which even now are high, will of course increase in like proportion.

The whole question of damage by weevils is at present something of a lottery at best, since not only orchards and groves but individual trees of the same variety are infested in widely varying degrees, and to a different extent each season. One plantation may be seriously injured during a season, while another a few miles away remains exempt; or one portion may be affected and the remainder left uninjured. The same is true of individual trees, although there are varieties, as the Cooper, which seems a special prey for the weevil at all times and places.

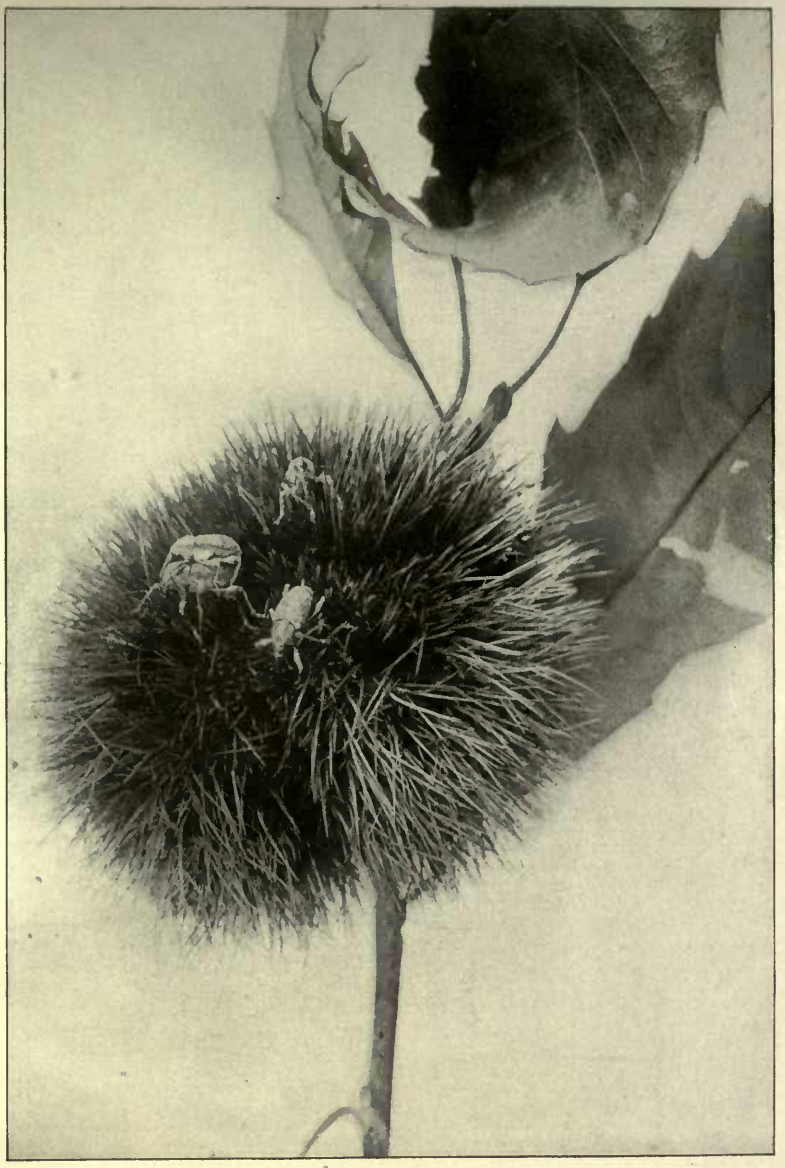
The chestnut weevil is of the beetle family of insects, and is one of the several species of curculio which infest nuts. The genus *Balaninus*, to which it belongs, includes seven species, all of which are nut weevils; but only two, viz., *B. caryatrypes* and *B. rectus*, work serious injury to the chestnut. It is the larval form of the insect which works within the chestnut and renders it unfit for use. The larva or grub is footless, white or cream colored, with a red or yellowish head, and a cylindrical body about half an inch long. The larvæ of *B. rectus* are of smaller size than those of *B. caryatrypes*. The adults are yellowish in color with rusty lines and spots on the wing covers, and are characterized by their extremely long and slender snout or beak. Their powers of flight are rather limited. In the male beetle the beak is about the length of the body; in the female it is twice as long as the body. The function of the beak is to pierce the immature burs and nuts and prepare a place for the reception of the eggs.

The life history of the insect, briefly stated, is as follows: The winged beetles appear about the time, or soon after, the trees begin to bloom; but egg laying is delayed until the staminate catkins drop, and the young burs are of considerable size. Then with their long beaks the beetles pierce a hole through the thick bur and into the tender nut itself and excavate a tiny cavity, in which the female deposits from one to four eggs. The tiny wound in the nut soon heals over completely, thus effectively protecting the eggs and grubs within. Eggs are often laid in different parts of the same nut; hence we frequently find the mature nuts harboring several grubs, sometimes as high as fifteen or twenty. As soon as the eggs are laid the winged beetles die, there being only one brood each season. The eggs hatch in a few days and the larvæ live and work within the growing nuts, reaching maturity about the time, or a little after, of the autumn ripening and falling of the



CHESTNUT WEEVIL (*Balaninus caryatrypes* Boheman).

THE LONG BEAK INDICATES THE FEMALE.



CHESTNUT WEEVIL—NATURAL SIZE.

IMMATURE BUR.

nuts. The time required by the larvæ to reach maturity is not fixed, but is governed by the time of ripening of the nut, which acts as host. In different varieties the grubs are always full grown when the nuts mature, even though the varieties ripen many weeks apart. The full grown larvæ bore out through the shell and enter the ground soon after the nuts fall, where they change into a pupa state, in which condition they remain dormant all winter. In the spring, after another transformation, they emerge in the adult beetle form, thus completing their cycle of existence, and are ready to perform the one function for which they were created, the reproduction of the species.

The full control of this weevil pest is as yet an unattained result. As with many other pests of this kind preventive measures, rather than remedial ones, are most effective. The one plan which aims to reduce the injury after it is done, is the scalding method already described under instructions for the care of the crop. This method, if immediately carried into effect upon the maturing of the nuts, makes most of the crop available for market, and kills all insect life in the gathered nuts, thus reducing the number which would prey on next year's crop, and saving a second resorting of the nuts before marketing. If left a few days without scalding, a basket of nuts often shows twice as many wormy ones as when set away, since many larvæ mature and leave within that time. The holes in the shells are always made from the inside by emerging larvæ. Sound nuts never become infested when mixed with wormy ones, because the larvæ pass the pupa state and winter in the ground, not in the nuts.

The preventive measures which may be practiced are many and are all good, since anything which reduces the number of insects will lessen the injury done during the subsequent year. To keep large flocks of guinea hens, turkeys and game chickens foraging among the trees is an excellent plan, as the number of adult insects and larvæ they will destroy is enormous. In order to prevent the larvæ from escaping into the ground the nuts and burs should be gathered the moment they are ripe, and immediately sorted and the defective ones destroyed ; or, if left unsorted, they should be thrown into tight bins or boxes to prevent the escape of the larvæ. Even the immature burs which fall early should be gathered and burned, and every precaution taken to destroy all existing larvæ. The Paragon burs which are picked and dried in the sun should be burned as soon as the nuts are extracted. It has been suggested that the curculio be shook from the trees into sheets, as is done with the plum curculio; but this would prove practicable only where the orchard or grove is small. A better method is to plant throughout the plantation varieties, like the Cooper, which are especially sought by the weevil, and destroy all

burs which form on them. Whenever possible the orchard should be located some distance from native chestnut woods, or, if a grove, all the trees should be cut off and grafted. Some means should also be taken to trap the winged beetles during the egg-laying period. As far as known no attempts have been made to spray the young burs with a solution which would kill or drive away the adult beetles. It is worthy of experiment. The various treatments just enumerated can be applied most advantageously in the chestnut orchard. The chestnut grove, however, if kept clean and free from underbrush also responds readily to treatments which help to reduce the beetles.

The Coppice Forest.

To those not sufficiently interested, or not so situated as to make the growing of chestnut trees for their nuts advisable, there still remains a profitable and interesting field of operations in the growing of the native tree for timber or fuel. This work may be loosely conducted or made intensive as desired.

Two systems present themselves. The one easiest of control and offering the quickest returns is the "coppice system." Under this system the forest is cut over clean with a rotation of about thirty years, the time depending on the use to which the timber is to be put. From the stumps thus left a new growth of sprouts spring up which are the basis of the new crop. The cutting should be done in the fall or winter, when the vital functions of the tree are at a low ebb and most of the sap is withdrawn from trunk and limbs. The stumps should be cut low and smooth. The sprouts which result from this system of forest management are very rapid in growth, and will furnish poles, posts and cross-ties in twenty to thirty years. The forest when once started may be left to itself; but it can be greatly improved by making thinnings and improvement cuttings, while the material thus removed can be utilized for fuel. This involves the removal of defective and crowded trees, and likewise those of other species which are of little value, or are around the more valuable trees.

The other system which may be recommended is that of "coppice with standards." This system is essentially the same as the one just described, except that in addition to the sprouts a number of seedling trees are left, or, if needs be, planted. These seedlings are not to be cut when the sprouts mature, but are left through two or three rotations of twenty or thirty years, so that they may attain a size suitable for lumber. The number left per acre may vary from 30 to 50.

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Summary.

Our native chestnut, although of unsurpassed flavor, is not desirable for general culture because of the small sized nut, irregular and non-prolific bearing, damage by weevils, and long time required to come into fruit. As a timber tree it is of recognized value and responds readily to several systems of forest management. Many varieties of chestnuts have been introduced from Europe and Japan, but of the large number imported but few have been found which are suited to our climate or possess commendable characters. Those retained are a valuable acquisition, and in size, productivity and rapidity of growth, are far superior to our native chestnuts for cultivated plantations. The Paragon, Numbo, and Ridgely of the European, and the Alpha, Reliance, and Parry of the Japanese varieties, are the most valuable.

Two general systems of chestnut culture are practiced, designated respectively as the "chestnut orchard" and the "chestnut grove." The first is composed of grafted seedlings set in orchard rows on cleared, usually improved, land. It offers advantages of location, ease of cultural control, and greater freedom from insect pests; but in general it is too expensive. The other system is an attempt to utilize waste forest land for the production of nuts. By this system a natural forest, in which the native chestnut is the predominant tree, is cut over, and the following year the one-year-old sprouts which spring up from the stumps are grafted to improved varieties. The Paragon stands first in general favor. In this system of culture the whip or tongue method of grafting has proved most successful. Returns from a grafted grove are early and the income large if no detrimental element enters. Insects and fire are the worst enemies, the former being the most injurious and hardest to control.

The American people have not yet learned the full value of chestnuts; but it seems probable that with a larger supply and an improved quality there will come a better appreciation of their food value, and a greater demand. In many European countries the chestnut has long been recognized as a cheap and nutritious food, and as such is extensively used. Chestnut culture in the United States is truly in its infancy as yet; but interest is rapidly being awakened, and in the near future a rapid advancement of the industry may be expected. If followed for pleasure, few branches of arboriculture possess greater fascination or offer a broader field for experimental work. If conducted as a business enterprise for profit only, there is offered a reasonably safe investment with quicker and higher returns than are assured by any system of forest management, while but few branches of horticulture are equally profitable.

In conclusion full credit must be accorded to the several men who aided the writer so materially in his investigations of the latest methods of chestnut culture, and without whose assistance the data and photographs herewith presented could not have been obtained. To Mr. Coleman K. Sober, Lewisburg, Pa., and Mr. Samuel C. Moon, Mooresville, Pa., especial thanks are due for their hospitality and valuable information regarding methods of grafting and general care of chestnut groves and orchards. From Prof. Nelson F. Davis, Bucknell University, many timely notes have been received, and by him many of the accompanying illustrations have been obtained and contributed. To nurserymen and horticulturists generally, who verbally and by correspondence have contributed to this article, the thanks of both the Commission and the writer are extended.

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